



# Update On BeiDou Navigation Satellite System

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**China Satellite Navigation Office**

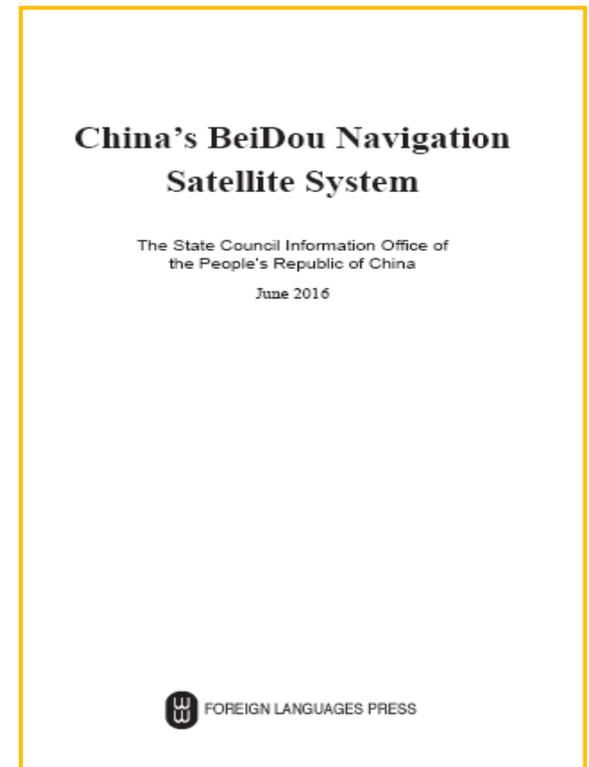


# Policy of Development

The whitepaper on BDS has been released in June 2016, to interpret its development concepts and propositions.

## 1. Providing Open Services Free of Charge

- **B1I and B2I open service signals are being broadcast by the operating BDS-2 to provide open services to the Asia-Pacific region free of charge.**
- **The services cover an area extending 55°N-55°S and 55°E-180°E, with positioning accuracy less than 10 meters, velocity measurement accuracy less than 0.2 meter per second, and timing accuracy less than 50 nanoseconds.**



## 2. Ensuring Safe and Reliable BDS Operations

- Improving the management mechanism on operation.
- Establishing a GNSS monitoring and assessment network.
- Taking a redundant and backup approach.

## 3. Disseminating BDS Information in a Timely Manner

- Publishing BDS documents related to open services and signals to provide inputs for global BDS product development efforts.
- Establishing a multi-channel information dissemination mechanism.

## 4. Improvement of BDS Performance

- **Providing global services.**
- **Strengthening service capabilities.**
- **Maintaining spatio-temporal reference.**

## 5. Protecting the Utilization of Radio-Navigation Satellite Frequency Spectrum

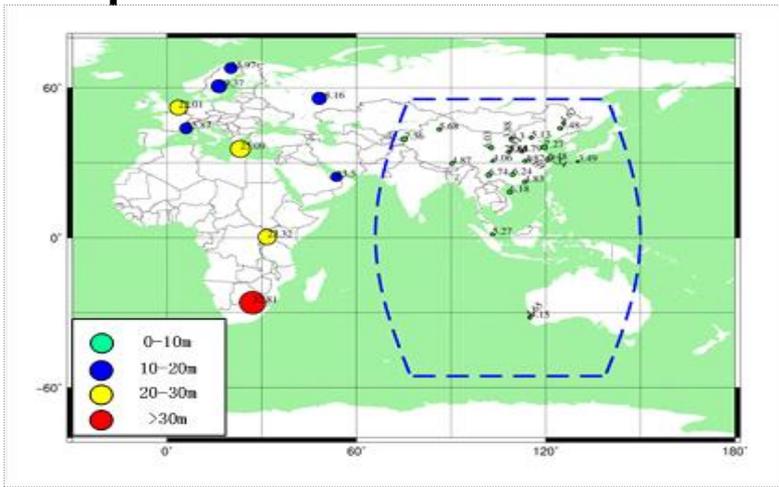
- **Protecting the radio-navigation satellite frequency spectrum has been listed in BeiDou project.**
- **A monitoring network for IDM will be established and the corresponding database will be also constructed.**
- **China prohibits the production, sale and use of illegal interference devices, investigates and punishes in accordance with the law any hostile interference actions which affect the system operations and services.**



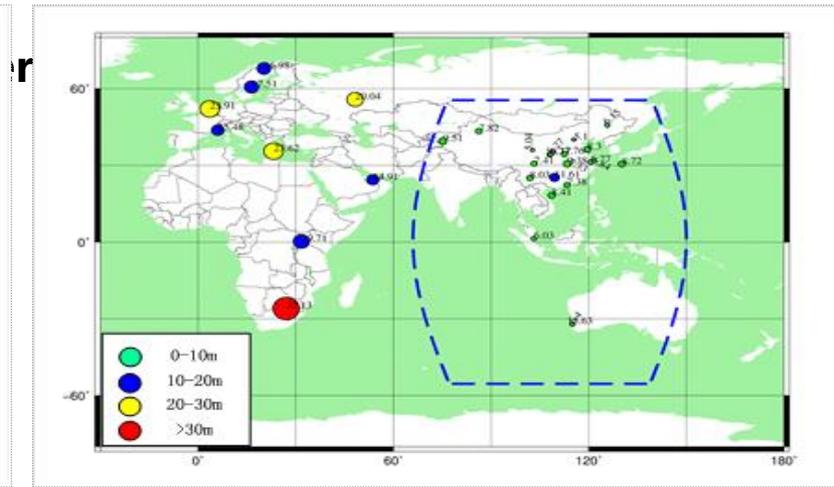
# 》 ( I ) System Construction

## 1. Steady Improvement of the BeiDou System Performance

- Since its formal regional service provision on December 27, 2012, BDS has maintained continuous and stable operation. The system service performance can satisfy the nominal requirements.
- Monitoring and assessment results of signals covering the Asian-Pacific region indicate that the BDS performance meets the specification.



B1I 平面定位精度



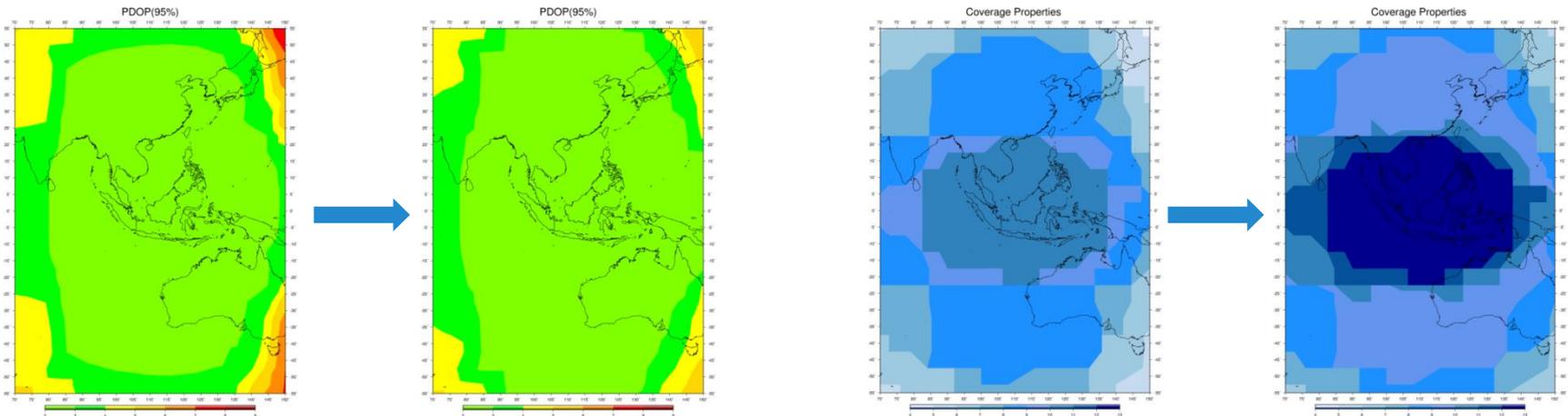
B1I 高程定位精度



# 》 ( I ) System Construction

## 1. Steady Improvement of the BeiDou System Performance

- After one IGSO and one GEO satellites were successfully launched, the average PDOP (95%) decreased obviously.



# » ( I ) System Construction

## 2. Demonstration of BD-3 Global System

- Since 2015, five new-generation BDS satellites have been successfully launched, including 3 MEO and 2 IGSO satellites.
- New signal structure has been designed and tested.
- The interlinks among the satellites have been realized, by which the accuracy of satellite orbit has been improved about 50% in 24 hour prediction.
- The accuracy of the satellite clock is also improved 60% in 24 hour prediction.



# ( I ) System Construction

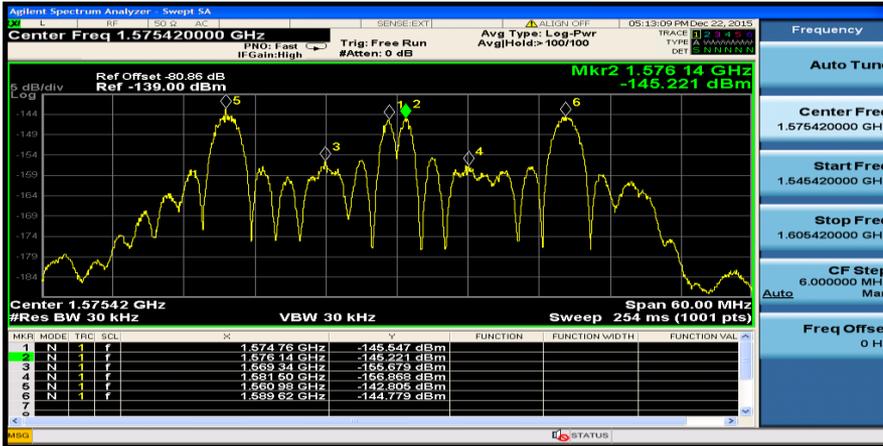
## 2. Demonstration of BD-3 Global System

- The new hydrogen clock has been equipped on-board with stability about  $6E-14/d$ , rather than the rubidium clock with stability of  $3E-13/d$ .
- The service capability is improved accordingly.

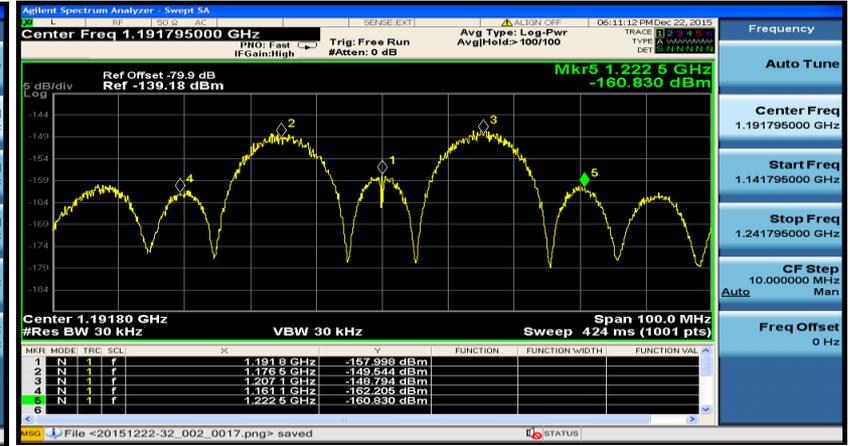


# ( I ) System Construction

- Spectrum of B1 and B2

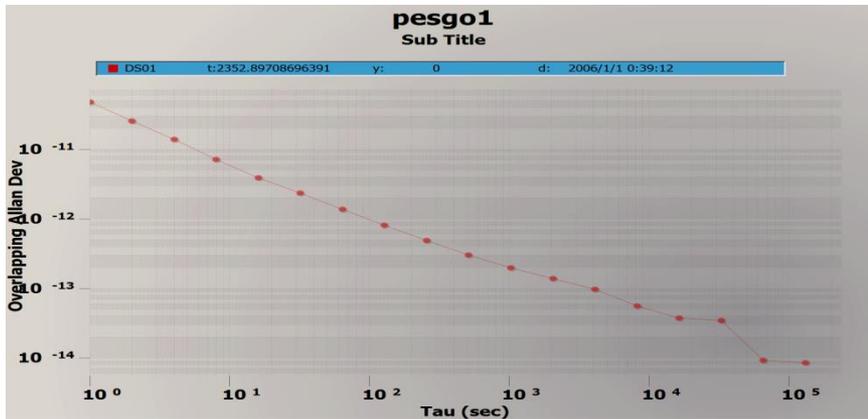


Spectrum of B1

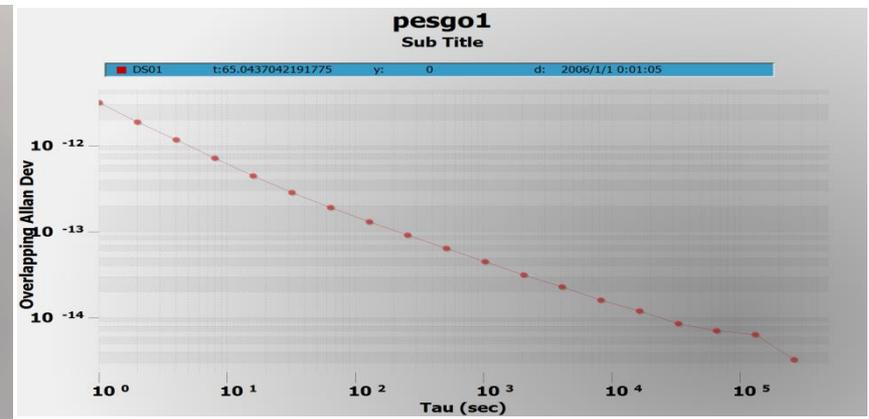


Spectrum of B2

- Stability of satellite clock



I1-S Stability



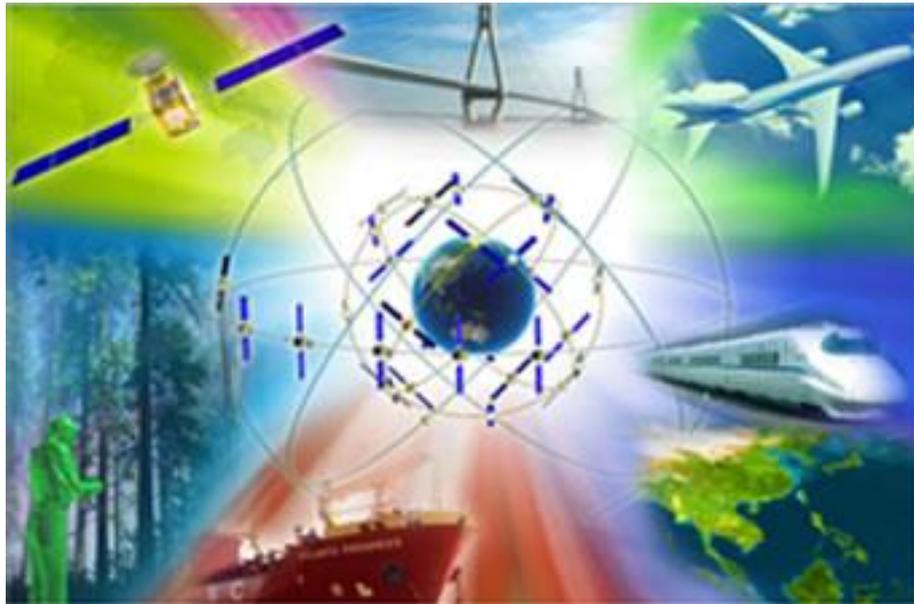
I2-S Stability



# » ( I ) System Construction

## 3. The Next Step for BD-3 Global System

- **BD-3 satellites will be launched intensively during 2017~2018.**
- **The system will possess the capability of the global PNT fundamental services in 2018.**
- **The full constellation with 30 satellites will provide global services for users of the worldwide in 2020.**

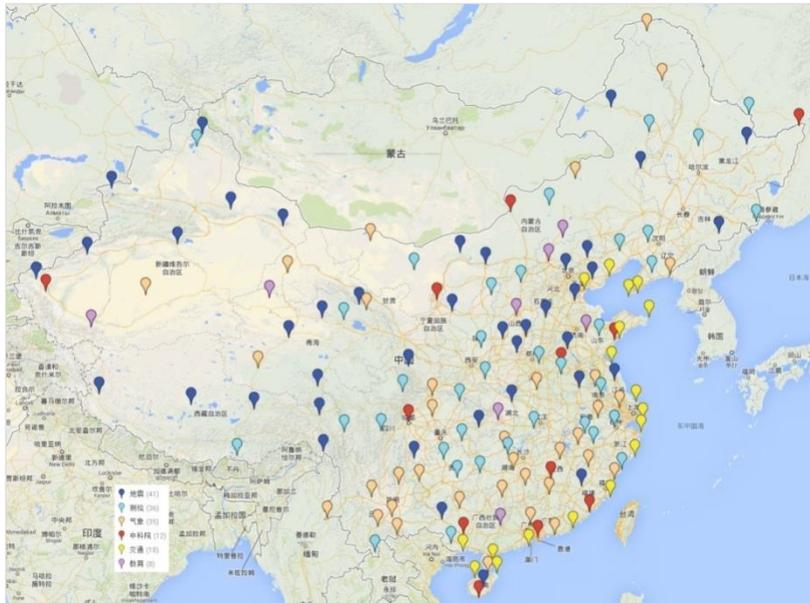


# ( I ) System Construction

## 4. Steady Construction of Augmentation System

### Ground-Based Augmentation System

- The basic system construction has been completed, while the positioning accuracy is under test, including meter and decimeter level for wide-area real-time services, centimeter level for the Beijing region, millimeter level for post-processing services.



Overall layout of National framework network reference stations



Completed 31 National framework network reference stations

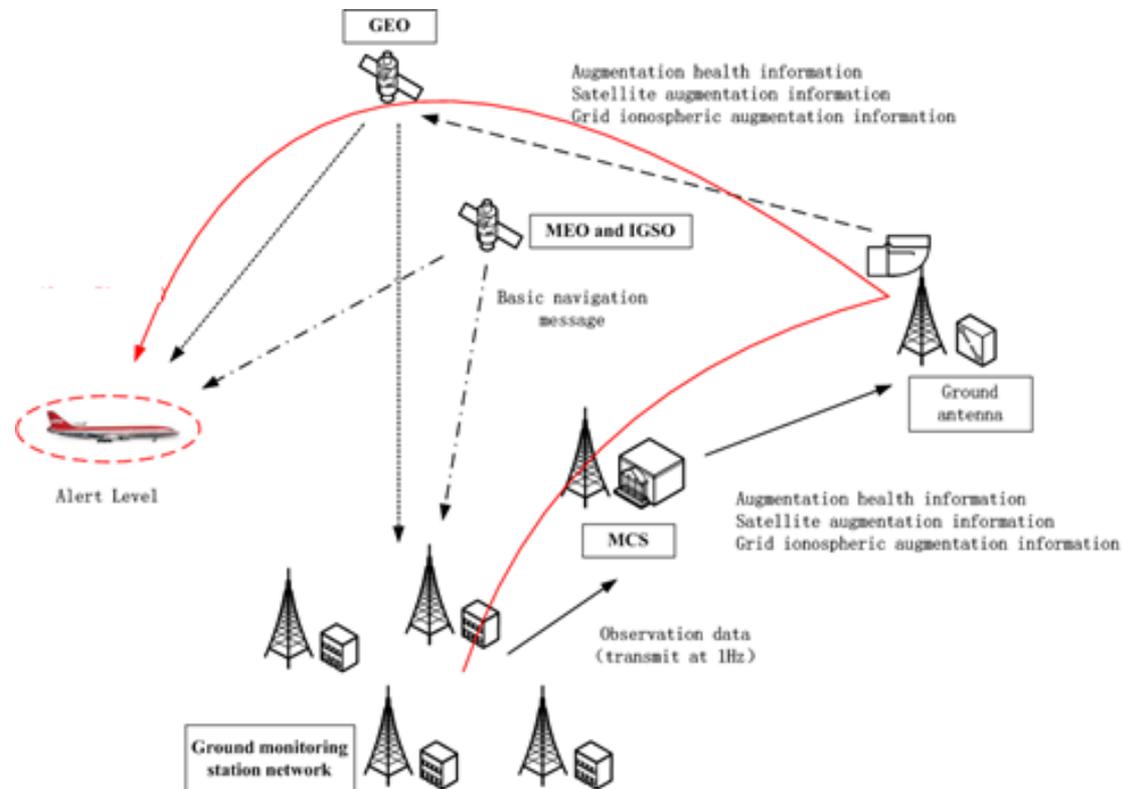


# 》 ( I ) System Construction

## 4. Steady Construction of Augmentation System

### Satellite-Based Augmentation System

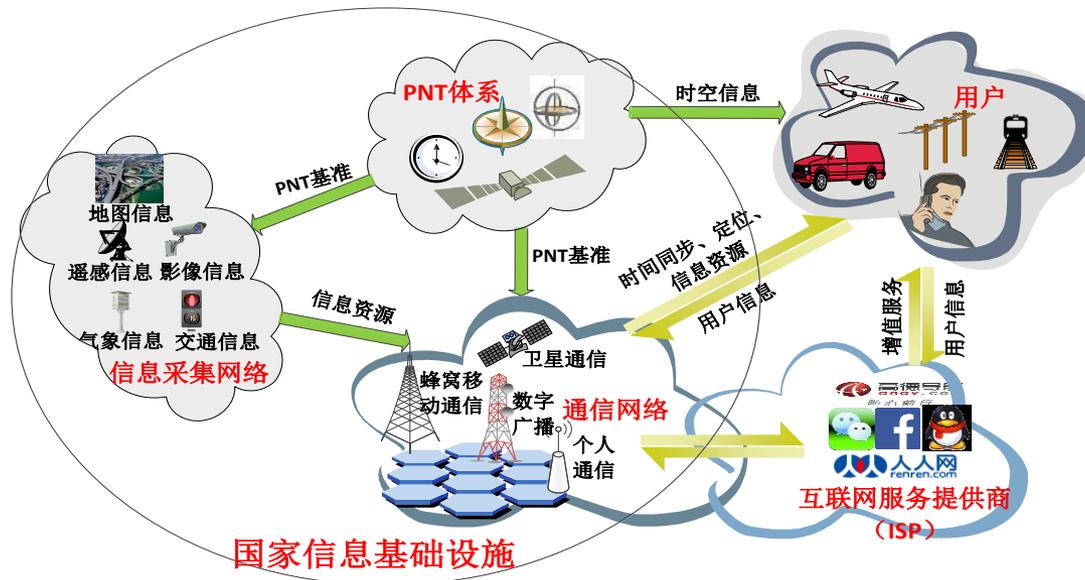
- BDS will comply with the international civil aviation standards, carry out the design, validation and construction of BeiDou Satellite-Based Augmentation System (BDSBAS), which will provide CAT-I services to civil aviation users in China and surrounding areas.
- At present, SBAS IWG has adopted BDS as one of the augmented objects of future satellite-based augmentation systems.



# Ⓢ ( I ) System Construction

## 5. Beginning of National Integrated PNT System Constructing

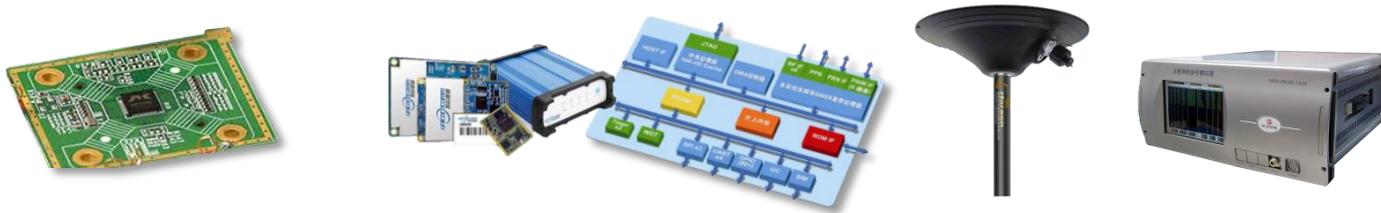
A national comprehensive PNT system is under study, and related technology is under research, so as to narrow the gap of satellite navigation services in some blind areas, such as in indoor, underwater, and deep spaces, to meet the needs of economic and social development.



# » ( II ) Application Promotion

## 1. Upgrade of Fundamental Products

- BDS fundamental products have been upgraded in terms of self-controlled intellectual properties, quality and quantity.
- BDS chips have entered a new era of 40-nanometer, and achieved a jumped upgrade from basic products to high-end industry.



- BDS/GNSS navigation chip/module, surpass 24 million pieces
- high-precision surveying boards, approximately 120, 000 sets
- navigation antenna, 4 million pieces
- high-precision antenna, surpass 500,000 pieces
- satellite navigation IP core used in mobile communication, approximately 18 million



# Application Promotion

## 2. Industrial / Regional Demonstration Applications are Steadily Pushed Forward

### Demonstrations in the Transportation Industry

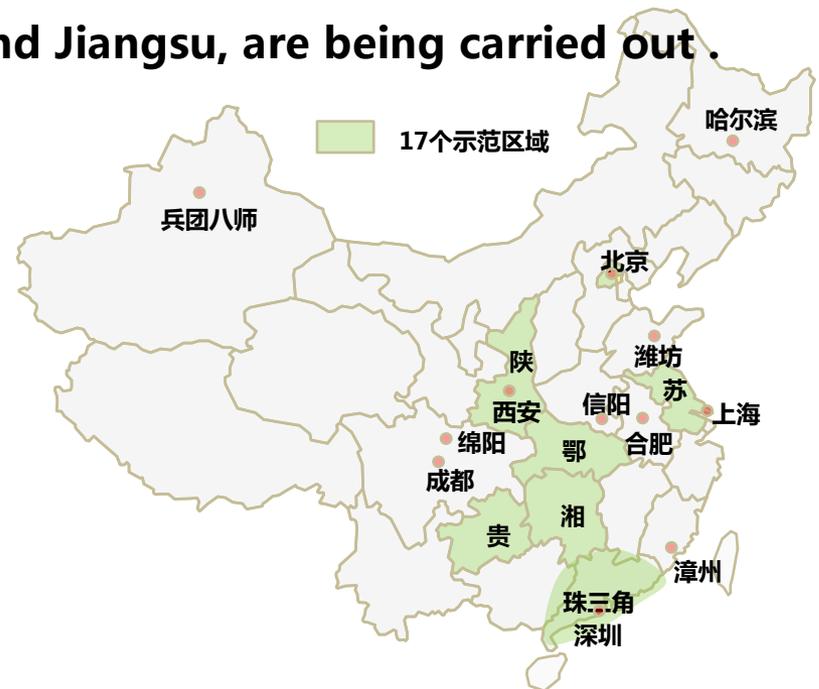
- A total of 3 million sets of BeiDou compatible terminals have been promoted and installed in the coach, tourism charter, dangerous goods vehicles and other key fields.



# 》 ( II ) Application Promotion

## 2. Industrial / Regional Demonstration Applications are Steadily Pushed Forward

- 11 industrial demonstrations, such as maritime transportation, meteorology, fisheries, public safety, disaster relief and civil affairs , as well as 17 regional demonstrations, like Pearl River Delta, Beijing, Shaanxi, Hunan, Guizhou, Hubei and Jiangsu, are being carried out .



# 》 ( II ) Application Promotion

## 3. Mass Market Applications Flourished

- With the development of some technologies, such as chip miniaturization, low power, low cost, and RF baseband integration etc., as well as extensive integration of satellite navigation IP core and mobile communications, BeiDou will be fully applied to the mass market and serve the public.



## ( II ) Application Promotion

### 4. Thrived Development of Industrialization

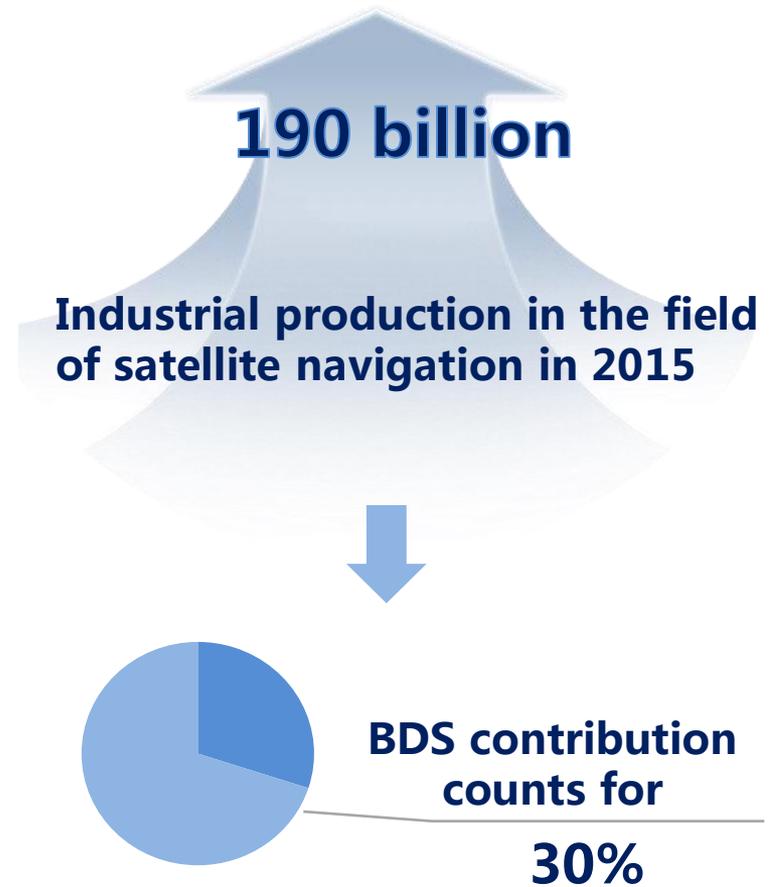
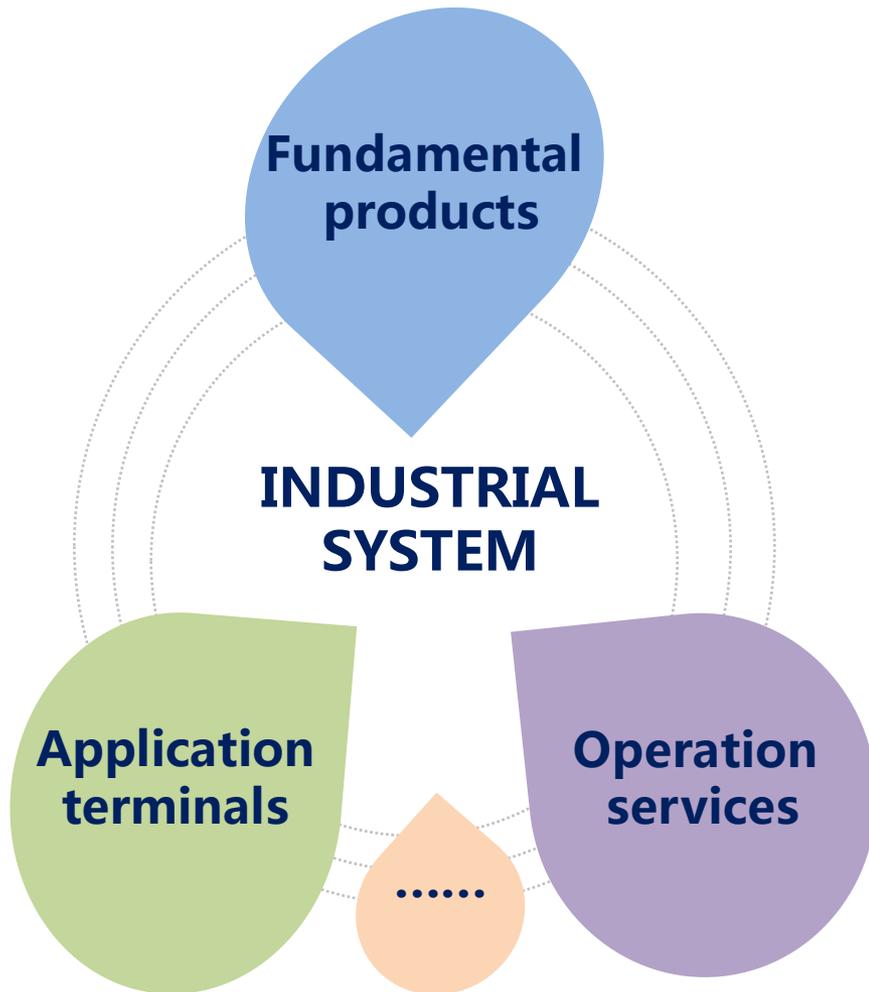
National medium and long term development program on satellite navigation industry and Medium and long term development program on national civil space infrastructure have been released, which makes the general planning and deployment in the long term development of satellite navigation industry at the national level.

BeiDou Navigation Satellite Standard System (version 1.0) and 17 BeiDou standards have been released, which will promote the construction of BeiDou navigation satellite standard system.



# » ( II ) Application Promotion

## 4. Thrived Development of Industrialization



# ( III ) International Cooperation

## 1 . Bilateral Cooperation

Keep coordinating with other navigation satellite systems in the sector of compatibility and interoperability, to jointly provide high quality services for users.

### China -Russia

- The Chinese-Russian Committee on Important Projects of Strategic Cooperation in the field of Satellite Navigation has been founded within the China-Russia Prime Ministers' Regular Meeting framework. The memorandum of understanding on satellite navigation cooperation has been signed. Working groups have been set up. The Joint Statement on GLONASS/BDS Compatibility and Interoperability and Navigation Technology Application cooperation has been released, and seven cooperation projects have been brought out.



# ( III ) International Cooperation

## China-U.S. Cooperation

- **The cooperation mechanism between BDS and GPS has been set up.**
- **The Joint Statement between these two systems was released.**
- **Cooperation has been carried out in the field of compatibility and interoperability, augmentation system and civil aviation application, civil service, monitoring and evaluation.**

## China -EU Cooperation

- **The frequency coordination towards navigation frequency channel between BDS and Galileo has been completed.**
- **The cooperation mechanism between these systems are under discussion, especially in the field of compatibility and interoperability.**



# 》 ( III ) International Cooperation

## 2. Participate in International Satellite Navigation Organization Activities

- Participated in the meetings of the ICG, ITU and other GNSS activities organized by the United Nations, and hosted the 30th SBAS IWG meeting.
- Attended the United States Positioning, Navigation and Timing (PNT) Advisory Board Meeting and ICAO Advanced Meeting for the first time in 2015, to carry out technical exchanges and cooperation.



## ( III ) International Cooperation

- **Host the China Satellite Navigation Conference, one of the largest GNSS conferences in the world**
- **Attend other international academic conferences in the field of satellite navigation**
- **Carry out the education and training on global satellite navigation, especially in the developing countries.**



# » ( III ) International Cooperation

## 3 . Integrate into the International Standardization

- Propel the recognition of BDS in international organizations such as IMO, ICAO and 3GPP.
- BDS has been ratified by IMO and become the global satellite navigation system supported by the international mobile telecommunications.
- The RINEX 3.03 standard which supports BeiDou was published in Jan 2016.







## Recent Plan

**Construct BDS global constellation, provide fundamental services for global users by 2018, and full services by 2020.**

**In the field of ground based augmentation, provide the trial services, including meter/decimeter-level positioning services to major regions nationwide, centimeter level to density regions, and millimeter-level post-processing services. Complete the construction of dense reference stations for the nationwide frame network by 2018.**

**Launch the first GEO satellite of BDSBAS around 2018. Provide BDSBAS services covering China and surrounding areas in accordance with international civil aviation standards in 2020.**





# SUMMARY

- **BDS has been providing stable services to the Asia-Pacific region, successfully launched next-generation BeiDou satellites to verify new technologies, deploy the BeiDou augmentation system from all-round scale, and steadily push forward the BDS construction.**
- **The BDS applications market has been preliminarily fostered, expanding from the typical industries to mass market, and the application industry is under fast development.**
- **BDS promotes cooperation among GNSS deeply , and keeps strengthening international exchanges.**



A satellite is shown in orbit against the backdrop of Earth. The satellite features a large, dark solar panel array extending from its main body. The main body is wrapped in gold thermal insulation and has several antennas and instruments protruding. The Earth's surface is visible below, showing blue oceans, white clouds, and green landmasses. The text "THANKS FOR YOUR ATTENTION!" is overlaid in a bold, yellow font across the center of the image.

**THANKS FOR YOUR ATTENTION!**